DYNARE WORKSHOP

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DYNARE

1. computes the steady state of the model
2. computes the solution of deterministic models (arbitrary accuracy)
3. computes first and second order approximation to solution of stochastic models
4. estimates (maximum likelihood or Bayesian approach) parameters of DSGE models
5. computes optimal policy in linear-quadratic models
6. simulates models with fully expected shocks
7. simulates learning models

The general problem

$$E_t \left\{ f(y_{t+1}, y_t, y_{t-1}, u_t; \theta) \right\} = 0$$

y : vector of endogenous variables

u : vector of exogenous shocks

Solution of deterministic models

- based on work of Laffargue, Boucekkine and myself
- approximation: impose return to equilibrium in finite time instead of asymptotically
- computes the trajectory of the variables numerically
- uses a Newton–type method
- usefull to study full implications of non–linearities

Stochastic models: First order approximation

In a a stochastic framework, the unknowns are the decision functions.
For a large class of DSGE models, DYNARE computes approximated decision rules and transition equations of the form

$$y_t = \bar{y} + A\hat{y}_{t-1} + Bu_t$$

with $\hat{y}_t = y_t - \bar{y}$.
Method proposed by Klein (2000) and Sims (2002).
DYNARE computes also theoretical moments and IRFs.

Second order approximation

Two features:

- decision rules and transition functions are 2nd order polynomials
- departure from certainty equivalence: the variance of future shocks matters

Decision rules and transition equations of the form

$$y_t = \bar{y} + A\hat{y}_{t-1} + Bu_t + 0.5\left(\hat{y}'_{t-1}C\hat{y}_{t-1} + u'_t D u_t\right) + \hat{y}'_{t-1}Fu_t + \Delta\left(\Sigma_u\right)$$

Method suggested by K. Judd, developped by C. Sims (2002), S. Schmitt-Grohe and M. Uribe (2003), F. Collard and M. Juillard (2000).

Estimation

DYNARE estimates the structural parameters of a model based on a linear approximation.
Estimation steps:

1. computes the steady state
2. linearizes the model
3. solves the linearized model
4. computes the log–likelihood via the Kalman filter
5. finds the maximum of the likelihood or posterior mode
6. simulates posterior distribution with Metropolis algorithm
7. computes various statistics on the basis of the posterior distribution
8. computes smoothed values of unobserved variables
9. computes forecasts and confidence intervals

Optimal policy

- Optimal Simple Rules (OSR)
  Dynare searches numerically the value of parameters of the policy function that minimizes weighted variances of endogenous variables
- Optimal Linear Regulator (OLR)
  Dynare computes the optimal linear regulator for a linear economy and a quadratic objective. This is the best possible linear policy, however it is time inconsistent.

Fully anticipated shocks

The model is extended as

$$E_t\left\{f(y_{t+1}, y_t, y_{t-1}, x_t, x_{t+1}, \ldots, x_{t+p}, u_t; \theta)\right\} = 0$$

y : vector of endogenous variables

u : vector of stochastic, zero–mean, exogenous shocks

x : vector of deterministic shocks

Future deterministic shocks are integrated to the state space.

Learning models

For learning models, it is necessary to specify the function that the agents use to update their knowledge of the parameter time unfolds.
Note that the agents solve a decision problem based on imperfect information, but that, in the simulation, the state of the model is updated with the true law of motion of the economy.
In Dynare, the agents' model is described in the model section and it is necessary for the user to write a loop that solves the model for each period, updates the parameters of the model perceived by the agents, and update the state of the model.